

in the South without a corresponding change in the North are based upon facts, and if so, it no doubt has formed theories regarding the same.

What mainly interests us is to know whether any conclusion has been reached as to the probable course the climate will take in the near future, that is to say, if it is at all likely that we have to deal with a fluctuation in the climate of which this is only the beginning, and which may extend over a considerable period, or if the climate may at any time return to its normal state.

In this connection it also occurs to us that we are in reality quite ignorant as to what may be considered the normal climate of South Carolina, and that there is a possibility that we are now returning to it, the preceding ten or twenty seasons being in reality abnormal ones.

If you will kindly give us the fullest information possible on this subject, which is of vital interest to us, and refer us to whatever literature may have a bearing upon it, we shall esteem it a great favor.

To the above letter the Chief of Bureau sent the following reply treating of the climatic question alone:

The subject concerning which you write is of transcendent importance; one that has been fruitful of much discussion during late years. It was brought to the front by the orange growers of Florida who, after having suffered from repeated disastrous freezes, naturally conceived the idea that the climate must have permanently changed. The pioneers of the middle west some years ago, in the belief that the rainfall to the westward was increasing, pushed out over the plains far beyond the borders of the humid region. After a year or so of abnormally heavy rainfall the natural conditions prevailed; conditions, it is needless to say, inimical to success in agricultural pursuits. Hundreds of persons were forced to abandon their claims and return to more humid regions.

Thus it is there arise from time to time, not only in this country but throughout the civilized world, apparently well grounded beliefs that the climate, either in respect to temperature or rainfall, has changed materially, or is slowly changing. That there have been marked changes in climate during the ages that have passed is clearly evidenced by the results of biologic and geologic surveys, not to speak of the results of equally important investigations that have been prosecuted in other branches of physical science. Such changes, however, occurred for the most part during the formative period of the earth's history and generally before it was inhabited by man. The occurrence of the Great Ice Age, the last important climate change, has been referred to purely astronomical causes, such as the secular or long periodic changes of the eccentricity of the earth's orbit and of the obliquity of the ecliptic, but there is not unanimity of opinion as to its probable cause.

The evidence of material change in climate during historic times is fragmentary and inconclusive. Strange as it may seem, instrumental data are not available in any part of the civilized world for a period longer than three hundred years, and even these are subject to an uncertainty of several degrees in the case of temperature, owing to the imperfections of the earlier instruments and methods. Then, too, the probable effect of man's occupancy of the earth is practically an unknown factor. Through his agency large portions of the earth's surface have been deforested and placed under cultivation. Water has been diverted from the streams and spread over the soil, thus transforming deserts into fertile plains. The latter in turn, through the varying fortunes of dynasties and empires, have again become arid and, with the onward march of progress, other portions of the desert regions of the globe have been brought under cultivation. While the total effect of such changes in the earth's surface as man has wrought is probably small, who can say that it has been absolutely nil?

It is the general belief in scientific circles that the radiating energy of the sun, upon which climate for the most part depends, has not altered within historic times, yet we can not argue constancy of climate from this fact alone, since the atmosphere becomes heated, not from the direct rays of the sun alone, but in great part from the ground by means of radiation, contact, convection, etc. The absorbing power of air for heat radiations is variable, depending somewhat upon the quality of aqueous vapor, carbonic acid, and dust that it contains. These, especially the latter, may have changed materially since the earth was inhabited by man. If we grant that the absorbing power of the atmosphere is subject to small variations from year to year we would still have an effect that would hardly be appreciable to the senses.

Passing now to the consideration of the facts named in your letter, I would say that the records of the Weather Bureau show that during the last fifty years there have been three marked cold periods in the South Atlantic States, viz, from 1852 to 1857, both inclusive; from 1871 to 1875, both inclusive; and from 1892 to 1901, both inclusive, a total of twenty-one years out of fifty. All of the years within the above-named periods were not uniformly cold; indeed, in the last-named period there were at least two normal winters, viz, those of 1894 and 1898. On the other hand, there occurred throughout the remaining periods of years cases of single cold winters, as that of 1878-79, and of two consecutive cold winters, as those of 1885-86 and 1886-87.

The damaging cold in the recent term of cold winters appears to have occurred, with but few exceptions, in February, and that fact may have impressed you more than would a continued cold in December or January. You have also unconsciously fallen into error in referring to the winter of 1889-90 as a standard of comparison. That winter was extraordinarily warm for the latitude of Charleston. In fact, the temperatures you experienced that season were appropriate to central Florida. There has not been another such winter as that of 1889-90 east of the Rocky Mountains since Weather Bureau observations began. You may remember that both November and December of 1889 were warm, pleasant months, and that there was practically no severe weather at Charleston during the entire winter. The warm weather was due to the fact that substantially all of the storms of the season passed across the country far to the north of Charleston, thus inducing warm southerly winds over the South Atlantic States. In cold years the interior of the country is covered by an area of high pressure, around the southern edge of which are found the conditions of heat and moisture necessary to the development of storms. You may recall that in cold winters the storms that visit your section generally approach by way of the lower Mississippi Valley or the Gulf of Mexico, and that they are almost invariably followed by cold northwesterly winds and several days of low temperature.

Why the storms of one year move in much higher latitudes than those of another year is one of the unsolved problems of meteorology.

We may add that inasmuch as the temperature and moisture of the soil is the primary consideration in the production of early spring crops, therefore the gardener must keep a record of the temperature at 3, 6, 12, and 15 inches below the surface of the soil if he wishes to understand the variations of his crops with the seasons. Such thermometer records should give indications as to when mulching and shading are needed, and enable one to predict quite closely the progress of development of roots, tubers, and sprouts.—C. A.

SEISMOMETERS IN METEOROLOGY.

Mr. F. Napier Dennison, of the Canadian Meteorological Service, stationed at Victoria, Vancouver Island, read a paper at the British Association at Glasgow on the seismometer as a weather forecaster. His paper in Symon's Meteorological Magazine for 1901 defends the idea that the seismograph can be used as a sensitive barometer. The seismographic pendulum points from the low barometer toward the high pressure. The enormous pressure taken off of the earth's surface within areas of low pressure and added to the pressure or weight over high areas, seems to make the crust of the earth bend like an elastic shell. Mr. Arthur Harvey, of Toronto, suggests that if at any station there be two good-sized seismometers of the pendulum type, oscillating at right angles, with perhaps a third between them, and if for convenience of observation the pens at the points of the swinging bars come close to each other, one would probably be able on the Pacific coast to tell the direction of an approaching low area.—C. A.

THE OBSERVATION OF SHOOTING STARS.

It is a very common matter for both regular and voluntary observers and occasional correspondents to mention the occurrence of a shooting star or bright meteor. Such events occur every day in many parts of the globe. Millions of meteors daily strike the earth's atmosphere and are burnt up, thereby adding a little to the mass of the earth and to the heat within the atmosphere; but the sum total of these effects is apparently inappreciable in meteorology. The real interest that attaches to the bright meteors is the effort to classify them according to the directions whence they come in space and the altitude and velocity with which they move. It is hardly worth while to mention the occurrence of a meteor unless the observer will add some approximate statement giving, as precisely as he is able to do it, the angular azimuth and altitude of that point in the sky where he first saw it and